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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to the high-corrosion-resistance surface treatment method which starts the surface treatment treatment technique of the sake on the corrosion resistance which makes a high-corrosion-resistance alloy layer form in the surface of the structure which receives the structure in a light water reactor, or neutron irradiation, and a stress-corrosion-cracking-proof disposition, especially contributes to reinforcement of a light water reactor plant.
[0002]
[Description of the Prior Art]Conventionally, the vacuum evaporation, the chemical vacuum deposition, physical vapor deposition, and ion implantation which a paint, plating as an electrochemical technique, etc. are utilized in ancient times as corrosion prevention measure art of a material-list side in which environment receives corrosion damage, and are performed by a vacuum atmosphere in recent years are being applied. It is in these methods mainly forming an anticorrosion metal coat in a material-list side only, and it cannot be said that the meaning of forming the film which improves adhesion with material and corrosion resistance is enough. On the other hand, the method of carrying out the surface treatment of the material-list side by an electron discharge method is proposed. For example, there are (I) JP,62-24916,A, (II) JP,2-83119,A, etc. A material-list side is fused and art which made the heat source the TIG arc which uses only the surface part of the presentation of material, consistency, or material as high corrosion resistant combination gold, or the laser beam, such as a TIG arc method or the laser method, is being applied.
[0003]
[Problem(s) to be Solved by the Invention]There are some technical problems in high corrosion resistant-ization of the lowered material-list side of the material-list side which is under

corrosive environment or has a possibility that it may be exposed to this environment, and corrosion resistance. The problem of the existence of the optimal method for 1st giving the problem of washing-izing of a treating surface and the 2nd high corrosion resistance to the surface is mentioned. Washing-ization of the treating surface is performed using the technique with which the purpose differs from anticorrosion-ization, for example, machining, and chemical and an electrochemical technique. However, in the surface treatment of the structure in a furnace of for example, the subject part covered with the corrosion-resistant lowered surface or corrosion product, and the light water reactor system, Since it is severe conditions of the work under a radiation environment, a technique with which surface-washing-izing and surface treatment art as pretreatment of a high corrosion resistant-ized surface treatment are made simultaneously is desired. Also in the usual surface treatment, it is unrelated in the shape of surface type, and the art in which surface state adjustment processing and high corrosion resistant-ized surface treatment processing can make simultaneous the surface which is not decontaminated has a large role over an industry top. There is a surface treatment method by an electron discharge method as art on which this technical problem is satisfied. It will progress by the heat input to an electron discharge method being small, and a surface alloying process carrying out the melting evaporation of an electrode and the surface treatment work by the minute discharge between an electrode and a surface treatment work, and carrying out melting of the congelation to the surface treatment work surface with evaporation of working liquid. Although the surface is alloyed by many duplication discharge, since the influence on a non-processed region is small, one discharge surface area and heat input are excellent also in the small deer as a surface treatment method of material.

[0004]Although (I) and (II) of the column of conventional technology are proposed as a high corrosion resistant-ized surface modification method by this electron discharge method, (I) It says that the indicated method will form an amorphous layer or fine crystalline layers, such as silicon (Si), in the surface treatment work surface by an electron discharge method, and there is a problem which must allocate layers, such as Si, in a conductive copper surface as an electrode. By the method indicated by (II) making the Si powder contributed to oxidation-resistant surface treatment mix into electric discharge machining liquid, and carrying out an electron discharge method, It says that the amorphous layer or fine crystalline layer of silicon (Si) will be formed in the surface treatment work surface, and there is a problem which must perform special processing to electric discharge machining liquid. When it was going to apply the art of the TIG arc method or the laser method independently, these surface-melting methods had the demerit which changes the physical properties of material around a surface treatment part, when it heated by high heat input.

[0005][sake / therefore / on the corrosion resistance of the surface of the structure as for which the purpose of this invention receives the structure in a light water reactor, or neutron

irradiation, and a stress-corrosion-cracking-proof disposition] The alloy or electrically conductive ceramics containing corrosion-resistant good elements or these elements is used as an electrode using electric spark forming, and it is in providing the high-corrosion-resistance surface treatment method which forms the electron discharge method alloy layer which has the surface state regulated treatment as pretreatment of a refining member surface, and high corrosion resistance.

[0006]Another purpose of this invention applies art, such as a TIG arc method or the laser method, for the electron discharge method alloy layer which formed the surface of the structure which receives the structure in a light water reactor, or neutron irradiation using electric spark forming further, It is in providing the high-corrosion-resistance surface treatment method which can form the remelting surface alloy layer which is excellent in corrosion resistance.

[0007]

[Means for Solving the Problem]To achieve the above objects, following methods are used as a surface treatment approach by this invention. Namely, iron (Fe) group alloys, such as carbon steel, low alloy steel, austenitic stainless steel, or ferritic stainless steel, The surface of a structure which receives a structure in a light water reactor or neutron irradiation which consists of a nickel (nickel) group alloy or a cobalt (Co) group alloy, Using an electrode which has at least one high-corrosion-resistance element, in the inside of an oil, or underwater, electron discharge method processing is carried out and an electron discharge method alloy layer excellent in corrosion resistance is formed in removal and this surface of an initial surface of said member.

[0008]Iron (Fe) group alloys, such as carbon steel, low alloy steel, austenitic stainless steel, or ferritic stainless steel, The surface of a structure which receives a structure in a light water reactor or neutron irradiation which consists of a nickel (nickel) group alloy or a cobalt (Co) group alloy, Electron discharge method processing is carried out in the inside of an oil, or underwater using an electrically-conductive-ceramics electrode, An electron discharge method alloy layer which consists of an amorphous layer which consists of a constituent element and an electrode component element of a member for processed, a fine crystalline layer, or a layer which ceramics particles distributed is formed in the surface at the same time it removes an initial surface.

[0009]In these surface treatment approach, it irradiates with energies, such as a laser beam, an electron beam, or a TIG arc, after forming an electron discharge method alloy layer by electron discharge method processing, After making some structures which receive a structure in a light water reactor or neutron irradiation which is an electron discharge method alloy layer and a member for processed remelt, rapid solidification is carried out and a remelting surface alloy layer is formed.

[0010]

[Function]In this invention, electron discharge method processing is carried out between an electrode and the metal which is material to be processed, and an electron discharge method alloy layer is formed in a surface of metal to be processed. A surface alloying process will carry out the melting evaporation of an electrode and the surface of metal to be processed by the minute discharge between an electrode and metal to be processed, and when the congelation fuses to a surface of metal to be processed and is alloyed with evaporation of working liquid, it will progress. Although the surface is alloyed by many duplication discharge, since the influence on a non-processed region is small, the heat input to one discharge surface area and an electron discharge method is excellent also in the small deer as a surface treatment method of material.

[0011]If it is in this invention, the combination of an electrode and metal to be processed is important. If what has a high-corrosion-resistance element is used as an electrode, a high corrosion resistance electron discharge method alloy layer will be formed in a surface of metal to be processed. If electrically conductive ceramics are used as an electrode, the electron discharge method alloy layer which consists of the amorphous layer which consists of a metaled constituent element and electrode component element, a fine crystalline layer, or a layer which ceramics particles distributed will be formed in a surface of metal to be processed. As for the thickness of an electron discharge method alloy layer, 5-20 micrometers is preferred.

[0012]Thus, since rapid solidification is carried out and a remelting surface alloy layer is formed after irradiating the formed electron discharge method alloy layer with energies, such as a laser beam, an electron beam, or a TIG arc, and making some of electron discharge method alloy layers and metal to be processed remelt, Corrosion resistance and stress-corrosion-cracking-proof nature can be raised without changing the physical properties of material a lot around a surface treatment part.

[0013]This invention, The weld zone containing the heat affected zone and melting solidifying part of the welded structure in a light water reactor which comprise the member and these alloy members of iron (Fe) group alloys, such as carbon steel, low alloy steel, ferritic stainless steel, or austenitic stainless steel, a nickel (nickel) group alloy, or a cobalt (Co) group alloy, Or chromium (Cr) which is a high-corrosion-resistance element about the surface of the structure in a furnace which has a portion which receives neutron irradiation, . Consist of any one or two ingredients or more among nickel (nickel), titanium (Ti), niobium (Nb), and tantalum (Ta). Or the corrosion resistance of this portion and stress-corrosion-cracking-proof nature are raised by making the electron discharge method alloy layer which has high corrosion resistance form at the same time it carries out electron discharge method processing in an oil or the working liquid of water and removes an initial surface, using as an electrode the alloy having contained them.

[0014]The principle of the surface treatment formation method of the member by this invention is explained using drawing 1. Drawing 1 is a mimetic diagram of electron discharge method processing of the high-corrosion-resistance surface treatment method by this invention. In the work tank 4 containing the working liquid 3 which is an oil or water, the metal 2 to be processed and the electrode 1 which are processed object materials are contained. The metal 2 to be processed is a member which consists of Fe group alloys, such as carbon steel, low alloy steel, austenitic stainless steel, or ferritic stainless steel, a Ni group alloy, or a Co base alloy.

It is the portion which received a weld zone or welding heat influence.

the electrode 1 -- Cr, nickel, Fe, Ti, Nb, and Ta -- inner -- it consists of any one or two ingredients or more, or the alloy having contained them is used. By sending pulse current through this electrode 1, and taking discharge 5 for it, melting and the evaporation of a part of electrode 1 and the surface part of the metal 2 to be processed are done, and an initial surface is removed, and that melting alloy grain 6 carries out cooling coagulation on the surface of the metal 2 to be processed with evaporation of the working liquid 3, and the electron discharge method alloy layer 7 is formed. Since the electron discharge method alloy layer 7 is a uniform layer according [including a high corrosion resistance alloy element] to rapid solidification, the oxide film is very stable, and improvement in corrosion resistance or stress-corrosion-cracking-proof nature is attained.

[0015]As a metallic material in which this invention is applied to be processed, In the case of what contains 12 to 20%, and nickel for Cr 8 to 30% by weight in the case of general carbon steel, low alloy steel, and austenitic stainless steel, and ferritic stainless steel. There is a thing which contains 12 to 18% and nickel for Cr less than 2% by weight, or a thing which in the case of a Ni group alloy contains Cr 15 to 23% and contains 2.5 to 37% and Mo for Fe 0 to 16% by weight.

[0016]The alloy which considers high corrosion resistance stainless steel, nickel which is Ni-group-alloy ingredients, Cr elements, or them as a presentation as an electrode material is preferred to electron discharge method alloy layer 7 high corrosion resistance formation. If the alloy which contains nickel, Cr elements, or them especially is used, to high-corrosion-resistant-izing on carbon steel and the surface of low alloy steel, it is suitable also because of [for surface nickel and high-concentration-izing of Cr] the formation of nickel content high corrosion resistant of ferritic stainless steel.

[0017]The meaning of using Ti, Nb, or Ta as an ingredient of an electrode material or an alloy electrode, It is in preventing them from carbon and nitrogen in working liquid, i.e., an oil, and underwater oxygen carrying out rapid solidification as a simple substance, mixing to an electron discharge method alloy layer, and causing material degradation, and making it adherence-ize to an electron discharge method alloy layer as a compound of Ti, Nb, or Ta. For

sufficient adherence-izing of carbon, oxygen, or nitrogen, it is preferred that the concentration of Ti, Nb, or Ta forms the electron discharge method alloy layer 7 of the content up to about 2% in the surface to all the members of Fe group alloys, such as carbon steel, low alloy steel, and stainless steel, a Ni group alloy, or a Co base alloy.

[0018]The refining surface of the metal which improved to be processed the corrosion resistance acquired by this invention, and stress-corrosion-cracking-proof nature, It is the electron discharge method alloy layer 7 formed by electron discharge method processing, and is the alloy structure containing the presentation of any one or two alloys or more of Cr, nickel, Ti and Nb which are used as an electrode, and Ta, and a working liquid presentation. Although it is dependent on electric discharge machining current, in order for the thickness of this electron discharge method alloy layer 7 to give a flatter surface state and not to have an excessive thermal effect on the base material (metal 2 to be processed) surface of the processing section circumference, it is preferred that it is in the range of 5-500 micrometers to carbon steel, low alloy steel, stainless steel, and all the Ni group alloys.

[0019]After electron discharge method processing, as for an excessive concentration rise, in order for Cr in the electron discharge method alloy layer 7 obtained by rapid solidification and Ni concentration to maintain the concentration grade of a base material (metal 2 to be processed), and connection to a base material presentation a sake [on the corrosion resistance accompanying surface treatment, and a stress-corrosion-cracking-proof disposition], avoiding is preferred. Since a toughness fall is produced especially in the concentration of Cr for the sigma phase formation by high-concentration-izing, a maximum is required also in order to prevent this. To austenitic stainless steel, 0.85 to 1.3 times, each concentration in a base material is preferred, and Cr in the electron discharge method alloy layer 7, and the amount of nickel Therefore, 1.1 to 1.3 times, About 8% from which the amount of nickel serves as 304 ingredients of SUS 0.83 to 1.5 times as desirable as the Cr concentration of a base material about 1.0 to 1.3 times and nickel addition to ferritic stainless steel in Cr, or more than it is preferred. It is good for the amount of Cr(s) to be 1.1 to 1.5 times to a Ni group alloy 0.83 to 1.5 times as preferably as the Cr concentration of a base material. In order to make the electron discharge method alloy layer 7 which is a surface layer SUS304 or a 316 austenitic-stainless-steel presentation in carbon steel or low alloy steel, the thing whose Cr concentration is 13% or less or whose Cr concentration 17 to 19% and Ni concentration is 9 to 12% by the weight in the electron discharge method alloy layer 7 is preferred.

[0020]The very good amorphous layer of corrosion resistance [alloy layer / 7 / which furthermore consists of elements, such as Cr, nickel, Fe, Ti, Nb, and Ta, / electron discharge method] is also obtained. Also when it is a fine crystalline, it becomes a metastable and uniform layer by rapid solidification, and corrosion resistance is good.

[0021]Although it consisted of any one or two ingredients or more in Cr, nickel, Fe, Ti, Nb, and Ta or the example using the alloy having contained them as an electrode has explained until now, As an electrode material, the ceramics electrode which has the conductivity of titanium boride (TiB_2), the titanium nitride (TiN) content sialon (Sialon), or silicon carbide (SiC) can also be used. An electron discharge method is carried out in an oil or the working liquid of water using this electrically-conductive-ceramics electrode, While removing an initial surface, the amorphous layer which consists of a metaled constituent element and electrode component element, a fine crystal layer, or the layer which distributed ceramics particles can be made to form in the surface of the metal which is processed material to be processed. It is the processing which makes it discharge in working liquid, make carry out melting of a part of electrode near the processing surface of metal in the surface treatment by an electron discharge method, and the electron discharge method alloy layer 7 which consists of the constituent element and electrode component element, and by which rapid solidification was carried out is made to form in a surface of metal to be processed. Use steel, stainless steel, Inconel, etc. as metal to be processed, and the above-mentioned thing is used as an electrode material, When it discharges in the working liquid which consists of an oil or water, the electron discharge method alloy layer 7 which consists of electrode components which control the metallic component which consists of Fe, Cr, nickel, C, etc. to be processed, and atomic diffusion, such as B, Si, and C, and by which rapid solidification was carried out is formed in the surface at the same time it removes an initial surface. An amorphous layer is formed when a cooling rate increases by control of a component range and spark discharge energy. When the above-mentioned alloy layer is amorphous structure with a stable oxide film, the corrosion resistance of a surface treatment part improves remarkably. Even when the above-mentioned alloy layer is not made amorphous, the corrosion resistance of the surface treatment part which consists of a quenching organization of a fine crystalline with a stable oxide film formed under corrosive environment improves greatly compared with a non-treatment material. When an alloy layer also doubles and has sufficient mechanical strength, stress-corrosion-cracking-proof nature also improves. When the above-mentioned alloy layer is the amorphous structure which has sufficient hardness, or even when not becoming amorphous, the abrasion resistance of the surface treatment part which serves as a quenching organization of a fine crystalline which has sufficient hardness, or a quenching organization which ceramics particles distribute improves remarkably compared with a non-treatment material.

[0022]Thus, when the adhesion of the electron discharge method alloy layer 7 and the metal 2 to be processed which were formed by electron discharge method processing is insufficient, Or when defects, such as a crack, are shown in the surface of the electron discharge method alloy layer 7, after forming the electron discharge method alloy layer 7, irradiate with the energies 9, such as a laser beam, an electron beam, or a TIG arc, remelt some of electron

discharge method alloy layers 7 and metal 2 to be processed, and a defect is disappeared, And the metal 2 to be processed and the stuck remelting surface alloy layer 10 can be formed. Since this layer is a rapid solidification layer by self-cooling, it excels in adhesion and an above-mentioned amorphous layer or uniform fine crystalline layer can be formed again. Therefore, the corrosion resistance of the portion in which this remelting surface alloy layer 10 was formed, and stress-corrosion-cracking-proof nature can be raised.

[0023]This invention into the portion into which corrosion resistance and stress-corrosion-cracking-proof nature deteriorated in the neutron flux measurement housing, the shroud, the shroud support, the top guide, the reactor core support plate surface, and the weld zone which are the structures in a light water reactor furnace. By carrying out an electron discharge method in an oil or the working liquid of water, and making the electron discharge method alloy layer 7 which has high corrosion resistance at the same time it removes the initial surface where the oxide film has adhered, or the remelting surface alloy layer 10 form, The corrosion resistance of this portion and stress-corrosion-cracking-proof nature are raised, and the life-span of [a light water reactor plant] is made to extend. Since the operation temperature of a boiling water reactor plant is about 288 **, Organization change to the extent that corrosion resistance is done in the case of crystallization of the above-mentioned amorphous layer or prescription change of a fine crystalline quenching organization, etc. and abrasion resistance is affected is not produced, but the characteristic of the structure in a light water reactor furnace improves greatly, and prevention of degradation of the many years past corrosion resistance of a light water reactor plant and correspondence power corrosion-cracking nature has a big effect.

[0024]

[Example]

(Example 1) Drawing 1 is a sectional view of the device which forms the electron discharge method alloying layer 7 which has the high corrosion resistance by electron discharge method processing. Electron discharge method processing is carried out between the electrode 1 and the metal 2 to be processed into the working liquid 3 which consists of oils. In this example, as a result of carrying out an electron discharge method, using Cr electrode as the electrode 1, using SUS304 stainless steel as the metal 2 to be processed, the electron discharge method alloy layer 7 with uniform about 5-micrometer thickness is formed, and very good corrosion resistance is acquired. Similarly, using SUS304 stainless steel as the metal 2 to be processed, when an electron discharge method is carried out using Ti electrode as the electrode 1, thickness is about 5 micrometers also about the electron discharge method alloy layer 7 formed, and very good corrosion resistance is acquired like the case of Cr electrode. These electron discharge method conditions make a parameter electrode polarity, current, pulse time, a quiescent period, and floor to floor time, and as shown in Table 1, they set them up.

[0025]

[Table 1]

電　極	Ｃｒ	Ｔｉ
電極特性	—	—
電　流	10A	10A
パルス幅	2μs	2μs
休止幅	16μs	16μs
加工時間	10～30min	

[0026](Example 2) Drawing 2 irradiates the surface part containing the electron discharge method alloy layer 7 formed by electron discharge method processing with the energies 9, such as a laser beam, an electron beam, or a TIG arc, and remelts some of electron discharge method layers 7 and metal 2 to be processed, It is a mimetic diagram in the case of making the remelting surface alloy layer 10 form by the rapid solidification by self-cooling. When the adhesion of the electron discharge method alloy layer 7 and the metal 2 to be processed is insufficient, or when defects, such as a crack, are shown in the surface of the electron discharge method alloy layer 7, The remelting surface alloy layer 10 which irradiated with the energies 9, such as a laser beam, an electron beam, or a TIG arc, from the working torch 8, remelted some of electron discharge method alloy layers 7 and metal 2 to be processed, and disappeared the defect, and was stuck with the metal 2 to be processed can be formed. Since this layer is a rapid solidification layer by self-cooling, it has the same good corrosion resistance as the electron discharge method alloy layer 7, and stress-corrosion-cracking-proof nature.

[0027](Example 3) Drawing 3 is a mimetic diagram in the case of carrying out electron discharge method processing to the system as an application of this invention for the purpose of improvement in the corrosion resistance in the inner surface of a tubular structure like the neutron measurement housing of a light water reactor, or stress-corrosion-cracking-proof nature. When the metal 2 which is a tubular structure to be processed is welded with other structures 14, such as a pressure vessel, and the tube interior which touches corrosive environment, such as furnace water, by the thermal effect of the weld zone 15 carries out sensitization, the stress corrosion cracking properties of the metal 2 to be processed deteriorate. The electron discharge method alloy layer 7 can be formed by electron discharge method processing as shown in Example 1 to such the part surface. The electron discharge method cell 11 attached to the rotation system member 12 held at the tip of the vertical-drive system rod 13 is moved by the drive to a hand of cut as it is vertical, an electron discharge method is wound so that the electron discharge method alloy layer 7 may be formed in this part surface that deteriorated, and it is ******. The electrode 1 shown in Example 1 is allocated

by the electron discharge method cell 11, maintaining appropriately the crevice between the metal 2 which is this electrode 1 and a tube interior to be processed, furnace water is used as the working liquid 3, and an electron discharge method is carried out. By this, the surface of the field where the tube interior deteriorated is reformed to the good electron discharge method alloy layer 7 of corrosion resistance or stress-corrosion-cracking-proof nature shown in Example 1.

[0028](Example 4) Drawing 4 is a mimetic diagram in the case of carrying out electron discharge method processing to the system as an application of this invention for the purpose of improvement in the corrosion resistance of a non-tubular structure like the shroud in a light water reactor, or stress-corrosion-cracking-proof nature. When the structure which touches corrosive environment, such as furnace water, by the thermal effect of the weld zone 15 of the metal 2 which is a non-tubular structure to be processed carries out sensitization, the stress corrosion cracking properties of the portion deteriorate. The electron discharge method alloy layer 7 can be formed by electron discharge method processing as shown in Example 1 to such the part surface. The electron discharge method cell 11 attached at the tip of the robot arm 16 is moved by the robot arm 16, an electron discharge method is wound so that the electron discharge method alloy layer 7 may be formed in this part surface that deteriorated, and it is ******. The electrode 1 shown in Example 1 is allocated by the electron discharge method cell 11, maintaining appropriately the crevice between this electrode 1 and the metal 2 to be processed, furnace water is used as the working liquid 3, and an electron discharge method is carried out. By this, the surface of the field where the structure deteriorated is reformed to the good electron discharge method alloy layer 7 of corrosion resistance or stress-corrosion-cracking-proof nature shown in Example 1.

[0029]In Example 3 or 4, when the adhesion of the electron discharge method layer 7 and the metal 2 to be processed is insufficient, or when defects, such as a crack, are shown in the surface of the electron discharge method alloy layer 7, The remelting surface alloy layer 10 which irradiated with the energies 9, such as a laser beam, an electron beam, or a TIG arc, remelted some of electron discharge method alloy layers 7 and metal 2 to be processed, disappeared the defect as shown in Example 2, and was stuck with the metal 2 to be processed can be formed. Since this layer is a rapid solidification layer by self-cooling, it has the same good corrosion resistance as the electron discharge method alloy layer 7, and stress-corrosion-cracking-proof nature.

[0030](Example 5) Like Example 1, the electrically-conductive-ceramics electrodes 1, such as the metal 2 to be processed, TiB_2, the TiN content sialon (Sialon), or SiC, are installed so that the distance between the electrode 1 and the metal 2 to be processed may become proper, and an electron discharge method is carried out on condition of Table 2. After a part of electrode 1 fuses by the energy of the discharge 5, it serves as the melting alloy grain 6, mixes

in the surface part of the metal 2 similarly fused by the energy of the discharge 5 to be processed and stops discharge, the electron discharge method alloy layer 7 which becomes a surface part of the metal 2 to be processed from a metallic component element and an electrode component element is formed.

[0031]

[Table 2]

電　極	Sialon	TiB_2
電極特性	—	—
電　流	10A	10A
パルス幅	2μs	2μs
休止幅	16μs	16μs
加工時間	10～30min	

[0032]When the oxide film of the above-mentioned electron discharge method alloy layer 7 is stable amorphous structure, the acid resistance of a surface treatment part and corrosion resistance improve remarkably, and in also having mechanical strength with the sufficient alloy layer 7 collectively, stress-corrosion-cracking-proof nature also improves. If it comprises a quenching organization which quenching organizations of the fine crystalline with a stable oxide film are consisted of, or ceramics particles distribute even when the above-mentioned alloy layer 7 is not made amorphous, The acid resistance of a surface treatment part and corrosion resistance improve greatly compared with a non-treatment material, and when the alloy layer 7 also doubles and has sufficient mechanical strength, stress-corrosion-cracking-proof nature's improve. The result of the SEM photograph of the section after the corrosion test of the electron discharge method alloy layer 7 formed of the electron discharge method using a sialon (Sialon) electrode, Also after forming the electron discharge method alloy layer 7 with uniform about 5-micrometer thickness in the surface of the metal 2 to be processed and making aqua regia immerse for 30 minutes, it turned out that there is ********** rather about corrosion damage as for nothing. Also by the result of the SEM photograph of the section after the corrosion test of the electron discharge method alloy layer 7 formed of the electron discharge method using a TiB_2 electrode. Also after forming the electron discharge method alloy layer 7 with the same uniform thickness as the surface of the metal 2 to be processed and making aqua regia immerse for 30 minutes, it turned out that there is ********* rather about corrosion damage as for nothing.

[0033](Example 6) Like what is shown in drawing 2, when the adhesion of the electron discharge method alloy layer 7 and the metal 2 to be processed is insufficient, or when defects, such as a crack, are shown in the surface of the electron discharge method alloy layer 7, Irradiate the electron discharge method alloy layer 7 which used the ceramics electrode for

the surface of the metal 2 to be processed, and was formed in it by electron discharge method processing with the energies 9, such as a laser beam, an electron beam, or a TIG arc, from the working torch 8, remelt some of electron discharge method alloy layers 7 and metal 2 to be processed, and a defect is disappeared, The remelting surface alloy layer 10 by self-cooling which carried out rapid solidification can be formed. Since this layer 10 is a rapid solidification layer by self-cooling, it can make an above-mentioned amorphous layer or uniform fine crystalline layer form again.

[0034](Example 7) The electron discharge method alloy layer 7 is formed, using an electrically-conductive-ceramics electrode as an application of this invention shown in drawing 3. It aims at improvement in the corrosion resistance in the inner surface of a tubular structure like the neutron flux measurement housing of a light water reactor, or stress-corrosion-cracking-proof nature. When the metal 2 which is a tubular structure to be processed is welded with other structures 14, such as a pressure vessel, and the tube interior which touches corrosive environment, such as furnace water, by the thermal effect of the weld zone 15 carries out sensitization, the stress corrosion cracking properties of a member deteriorate. The electron discharge method alloy layer 7 which consists of a quenching organization which amorphous structure as showed in Example 5, a fine crystalline, or ceramics particles distribute by an electron discharge method can be formed to such the part surface. A hand of cut is made to drive the electron discharge method cell 11 as it is vertical, an electron discharge method is wound so that it may be formed in the part surface on which the electron discharge method alloy layer 7 deteriorated, and it is ******. thus, good ARUMO of the corrosion resistance which showed the surface of the field where the tube interior deteriorated in Example 5, or stress-proof **** crack nature -- face -- it reforms to the electron discharge method alloy layer 7 which consists of an organization, a fine crystalline organization, or a quenching organization that ceramics particles distribute.

[0035]as opposed to the surface of a structure where abrasion resistance deteriorated by the long term deterioration of the plant -- the same processing as the above -- wear-resistant good ARUMO -- face -- the electron discharge method alloy layer 7 which consists of an organization, a fine crystalline organization, or a quenching organization that ceramics particles distribute can be formed.

[0036]Since the operation temperature of a boiling water reactor plant is about 288 **, organization change to the extent that corrosion resistance, stress-corrosion-cracking-proof nature, and abrasion resistance are affected in the cases, such as crystallization of the above-mentioned amorphous layer or prescription change of the quenching organization of a fine crystalline, is not produced. Therefore, the above-mentioned characteristic of the structure in a furnace improves greatly, and prevention of the long term deterioration of a light water reactor plant has a big effect.

[0037](Example 8) the method shown in Example 5 as an application of this invention shown in drawing 4 -- the example aiming at improvement in the corrosion resistance in the surface of a non-tubular structure like the shroud of a light water reactor, shroud support, a top guide, and a reactor core support plate or stress-corrosion-cracking-proof nature is shown. When the structure which touches corrosive environment, such as furnace water, by the thermal effect of the weld zone 15 of the metal 2 which is a non-tubular structure to be processed carries out sensitization, Or when the stress corrosion cracking properties of a structure deteriorate under the influence of neutron irradiation, The electron discharge method alloy layer 7 which consists of a quenching organization which is amorphous structure and fine crystalline organized or ceramics particles distribute by an electron discharge method as shown in Example 5 can be formed to such the part surface. The electron discharge method cell 11 attached at the tip of the robot arm 16 is moved by the robot arm 16, and an electron discharge method is repeated so that the electron discharge method alloy layer 7 may be formed in this part surface. Thus, the surface of the field where the structure deteriorated is reformed to the electron discharge method alloy layer 7 which consists of the good amorphous structure of corrosion resistance or stress-corrosion-cracking-proof nature which showed in Example 5, a fine crystalline organization, or a quenching organization which ceramics particles distribute.

[0038]The electron discharge method alloy layer 7 which consists of a quenching organization which is wear-resistant amorphous structure [good] and fine crystalline organized by the same processing as the above, or ceramics particles distribute also to the surface of the wear-resistant structure which deteriorated by the long term deterioration of a plant can be formed.

[0039]In Example 7 or 8, when the adhesion of the electron discharge method alloy layer 7 and the metal 2 to be processed is insufficient, or when defects, such as a crack, are shown in the surface of the electron discharge method alloy layer 7, as it is shown in Example 6, the remelting surface alloy layer 10 may be formed.

[0040]

[Effect of the Invention]Since the extremely outstanding alloy layers, such as corrosion resistance and abrasion resistance, can be given to the metallic material surface according to this invention, the improvement in character of material and parts of which such the characteristic is required has a big effect. Since surface treatment is possible and the corrosion resistance of the structure in a furnace, stress-corrosion-cracking-proof nature, and abrasion resistance can be raised by alloy layer formation-ization to the structure in a light water reactor furnace, the avoid accident of a light water reactor or reinforcement has a big effect.

[Translation done.]